ANIMAL PRODUCTS IN THE DIETS OF PRESENT AND FUTURE WORLD POPULATIONS 1/

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We who live in the United States, and in Canada, accept as the norm a dietary pattern built around meat and other animal products. We share this pattern with a minority of the people of the world. For the majority, the normal diet is built around plant products, and often around the produce of a single plant such as rice, wheat or cassava.

Since animal products occupy such an important place in our diets, our animal industry, on the whole, enjoys a strong demand for its products. However, that industry has not been without its challenges. Lard, once the leading shortening in American kitchens, has yielded its place to shortenings made from vegetable oils. Butter, once the basic spread for American bread, has been challenged by spreads manufactured from plant sources. Other challenges will come in the decades ahead, as population pressures increase, and as patterns of land use change. But, for now, we are generally concerned as much over the quality of a steak as we are with the price, and the question of availability of our favorite cut usually does not arise.

In those areas where most of the world's people live, and where rural populations continue to overcrowd the already overcrowded land, the problem is whether or not the extremely low levels of animal products in the diet can be increased by some small degree, or even if those low levels can be maintained.

It is not possible, either within the limits of my time or my competence, to deal with all the problems of providing animal products in the diets of present and future generations. Yet, as is indicated by the subject assigned to me, I am expected to take a global view, to use the world's horizon as the horizon of my thoughts, and to look beyond today's horizon into tomorrow's world.

In examining this problem, we must recognize that we live in a world of change. An agricultural revolution is now well advanced in the more highly-developed countries, a revolution with its attendant surpluses of some products, but this revolution has touched only to a limited extent the traditional methods which dominate the agricultural scene in less-developed countries. Further changes are certain to come, in both the developed and the less-developed countries, as a result of new scientific developments and their application,

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as a consequence of what have been called the rising expectations of the less-developed areas of the world, and as a consequence of rising populations. The livestock industry will be affected by those changes and will participate in them. One of the major problems before us, if not the major problem, is whether the consequences of rising populations will be such as to prevent the realization of rising expectations.

In order to get at the nub of the problem, let us first examine the adequacy of present food supplies in relation to nutritional requirements, then consider the variations which now exist in the capacity to produce animal products in different parts of the world, after which we may examine the overall land use pattern and how land availabilities will probably change as a result of increasing population pressures. Against this background, it should be possible to arrive at some broad estimates of what lies ahead for the producer and consumer of animal products.

Adequacy of Present Food Supplies

Data on supplies of calories, and of total and animal protein, probably provide the best indications we have available as to the quantitative and qualitative variations which exist in the diets of peoples in different parts of the world.

We have reasonably reliable estimates for 43 countries, groups of countries, and territories, of the average calorie content of national food supplies per person per day (FAO, 1961). These data form the basis for the graph in Figure 1. The estimated number of Calories available varies from 3,750 per day in Ireland to 1,940 in Pakistan. In the series, Canada ranks sixth and the United States seventh. It is difficult to estimate how many of these countries have supplies of Calories adequate to meet nutritional needs, since calorie requirements vary with a number of factors - body size, sex, physical activity, age, external temperature, pregnancy and lactation. FAO (1957) has published a method of arriving at calorie requirements, based on a standard "reference man" and a "reference woman", which takes into account these several factors. Application of this method to whole populations in a few countries indicates, for example, average requirements per person per day of 2,610 Calories in the United States, 2,310 Calories in Japan, and 2,230 in India (Phillips, 1957). Of the 43 countries included in Figure 1, seven fall below the indicated requirement for India, eleven fall below the indicated requirement for Japan, and nineteen below the 2,610 Calorie level indicated as the calorie requirement in the United States. Incidentally, although we tend to be a nation of calorie watchers, the Calories available in our national food supply indicate that we exceed our average requirement by 520 Calories per person per day, while India has a deficit of 280 Calories per person per day.

FAO (1961) has also published estimates of the total protein and animal protein contained in national food supplies of the same 43 countries. These data are expressed in terms of grams per person per day. The countries are listed in Figure 2/ descending order of the level of total protein available. For total protein, they vary from 105 grams per person in New Zealand to 43 grams in Ceylon, while the amount of animal protein in the food supply varies from 72 grams per person per day in New Zealand to 7 grams in Ceylon and Pakistan and 6 grams in India. In total protein Canada ranks third and the United States eleventh. For animal protein, the United States ranks second and Canada third.

The broken horizontal lines in Figure 2, at the 70 and 33-gram levels, refer to suggested optimal levels of total protein and animal protein per person per day (Morris, 1945). Fifteen of the 43 countries fall below the suggested optimum level of total protein. Of the twenty-eight countries having more than 70 grams of total protein per person per day, nine fall below the 33-gram level of animal protein. From left to right, these are Yugoslavia, Greece, Turkey, Italy, Chile, United Arab Republic, Spain, Union of South Africa and Syria. All of the fifteen countries falling below the 70 gram level of total protein also fall below the 33-gram level of animal protein, most of them having intakes well below this suggested optimum level. The tentative optimum levels of protein proposed by Morris, based on recommendations of the National Research Council in the United States (see N.R.C., 1948), can only be taken as general guides which would have to be adjusted for various factors affecting protein requirements. FAO (1957a) has published an analysis of variations in protein requirements per unit of body weight at different ages (see Figure 3), and has emphasized that these are tentative requirements, assuming that all proteins supplied are of high nutritive value, no significant losses occur through incomplete digestion, the diet does not vary greatly from meal to meal, meals are evenly spaced, and disease and parasitic infection are absent. Requirements would be increased by pregnancy, lactation, heavy work and may also result from chronic disease, so variations among countries in these factors, as well as in age and weight, would have to be taken into account in estimating average national requirements per person.

If we reassemble the data for calorie, total protein and animal protein supplies of these 43 countries in one graph, the countries being listed in descending order of calorie intake, as has been done in Figure 4, it will be seen that there is a general tendency for those countries having limited supplies of Calories to also be short in their supplies of total protein and animal protein.

Another approach to the problem of variations in food supplies, and which may be more easily grasped by those accustomed to thinking in terms of meat and potatoes, is to consider the degree to which countries depend upon cereals and starchy root crops such as potatoes, sweet potatoes and cassava. FAO (1961) has published data for 47 countries, groups of countries and territories, and the graph in Figure 5 is based on these data, recalculated to express the portion of calories from starchy foods in percentages. These percentages vary from a high of 75.5 for China (Taiwan), followed closely by Pakistan, and Rhodesia and Nyasaland, to lows of 25.6 for Canada and 24.2 for the United States.

I have limited myself to the use of protein as a measure of quality of the diet. Such data are not at hand for minerals and vitamins, although it seems certain that there are also wide variations in the availabilities of these dietary essentials.

Variations in Present Supplies of Livestock Products

The wide variations in availability of animal protein for consumption, as brought out in Figures 2 and 4, reflect substantial variations among countries and regions in their capacities to produce meat, milk and eggs, or in their economic capacities to procure these products.

There are some 6,000,000,000 head of livestock and poultry in the world, or about twice as many animals and birds as there are people (Phillips, 1962). According to FAO (1961) statistics, man harvests from these animals and birds, for each person each year, on the average, about 20.5 pounds of beef and veal, 4.2 pounds of mutton, lamb and goat meat, 20.3 pounds of pork, 9.6 pounds of hens' eggs and 250.3 pounds of milk. But these are only averages around which countries and regions vary widely in their capacities to produce animal products.

For example, there are wide variations in production of beef and veal, even in countries with a long tradition of beef production, consumption and in some cases export. New Zealand and Australia produce about 221 and 164 pounds, respectively, per person per year, while in Canada and the United States production levels are about 85 and 79 pounds. All these levels are extremely high when compared with the 2.5 pounds produced per person per year in the Far East region, taken as a whole. Among our neighbors in Latin America, beef and veal production is very high in some countries, low in others. For example, Argentina produces about 206 pounds per person per year, while Ecuador produces 18.4 pounds or less than one-tenth as much.

Differences in levels of production for pork are less striking than for beef, but are nevertheless substantial. Here in the United States, and in Canada, annual production is about 58 pounds per person, while in New Zealand and Australia the levels are about 39 and 22 pounds respectively. But in the Far East production is at about the same low level as for beef, or just under 2.5 pounds per person per year.

On the other hand, differences in levels of production for mutton and lamb, including goat meat, are even more striking than for beef. In round numbers, New Zealand produces 400 pounds each year per person in that country. Australia produces about 125 pounds, while, in the United States we produce only 3.8 pounds, and in Canada about 2 pounds per person. In the Far East, average production is only about 1.2 pounds per person per year.

The total meat supply from bovines, swine, sheep and goats in the Far East thus adds up to about 6.2 pounds per person per year. This would not go very far in filling the weekly market basket of most American families, for in relation to our annual consumption of meat from these same sources, 6.2 pounds would provision an average person for only 16 1/2 days, and a family of five for only 3 1/3 days.

Eggs, too, are in short supply in many countries. Here in the United States we harvest about 44.2 pounds of hens' eggs per person per year, while in Canada and also in New Zealand the production level is approximately 38 pounds per person. But in the Far East, only about 2.3 pounds are produced per person per year. This is the equivalent of about one medium-sized egg every three weeks for each person.

We usually think of milk as an essential part of a well-balanced diet, but it too is in short supply in many countries, compared with countries in which dairy production is traditionally high. New Zealand harvests about 4,953 pounds of milk for each person per year, Denmark 2,454 pounds, and the Netherlands 1,273 pounds. By comparison, Canada produces 1,034 pounds, the United States 680 and Ecuador 211. But in the Far East the annual harvest is only 71 pounds per person, on the average. Of this, only 32 pounds or less than half, is produced by cows, while the production from water buffaloes and goats averages about 35 and 4 pounds, respectively, for each person.

Many more examples could be cited to show the wide gaps that exist between countries which are in a position to build their diets around meat and other animal products, yet in some cases to have substantial quantities available for export, and those which depend primarily upon plants for their food supplies. But these few examples should suffice to emphaisze the extreme variations among countries and regions which result from differences in population density, differences in the overall patterns of agricultural production, and differences in levels of production per animal or per bird.

Before leaving the subject of availability of animal products, I must take note of fish as a source of animal protein. Of an annual catch amounting to 41 million metric tons, about 73.2 percent is used for human consumption. This amounts to about 22 pounds per person on the average, compared with 20.5 pounds of beef or 20.3 pounds of pork.

Expanding Populations and Shrinking Land Resources

The marked differences that now exist among countries in their capacities to produce meat, milk and eggs, and to provide reasonable levels of animal and other proteins for their peoples, lead us to the questions: what are the possibilities of increasing levels of animal protein in areas where these levels are now low? Will those countries which now enjoy high levels of animal products be able to maintain such levels in the decades ahead? If we are to face these questions in a realistic way, we must take into account the rapid build-up of the human population - a build-up so rapid that there may be something like 6,280 million people to feed by the turn of this century and perhaps somewhere in the vicinity of 13,000 million or 13 billion by 2050 A.D. If this rate of expansion in population is realized, and there is no change in the amount of arable land, we will have just over half an acre per person in 2000 A.D., and about a quarter of an acre per person in 2050, compared with about 1.18 acres in 1959. Thus, to maintain present levels of consumption, the average acre would have to produce twice as much within forty years and five times as much in less than a century.

Some background for the foregoing estimates may be useful. The United Nations (1958) estimated that the population might reach a high level of 6,900,000,000, a medium level of 6,280,000,000 or a low level of 4,888,000,000 in 2000 A.D., depending upon the assumptions used in arriving at the respective estimates. The medium assumption appeared to be most plausible. It was based on an assumed increase of 53 percent between 1950 and 1975 and a 64 percent increase between 1975 and 2000.

Any attempt to estimate the trend beyond 2000 is, of course, subject to so many unknowns that it could have little reliability. However, at the present annual rate of increase, about 2 percent, the population would double every thirty-five years (Dorn, 1962; Population Reference Bureau, 1962). In its study, the United Nations speculated that, even if it were conceded that the rate of growth might reach a peak near the end of this century, and might diminish gradually and cease within another century, the world population would not stop growing until it had reached between 10 billion and 25 billion. This speculation leads to the question, is such further growth possible, and if so, can the vast changes in human organization required to sustain it be conceived and possibly achieved?

On the question of carrying capacity of the world, the United Nations (1958) study points out that the more serious estimates, subject to particular assumptions made in each instance have resulted in figures varying from 5 billion to 16 billion. Such estimates will no doubt require revision as both the science and practice of agriculture advance. Another more optimistic estimate mentions a possible carrying capacity as high as 50 billion (Bonner, 1961). Even such an optimistic estimate has little meaning when compared with estimates of potential populations when we contemplate the future and go statistically a bit berserk. According to one recent calculation (Bonner, 1961), if the present rate of growth continues, we shall have only land area enough in 700 years for each person to stand shoulder to shoulder; and in 7000 years the solid mass of humanity would be expanding outward from the whole of the earth's surface into space at the speed of light. Another such estimate, obviously based on a somewhat faster rate of reproduction, indicates that we would have reached this speed of outward projection by 6000 A.D., or only a little over 4000 years hence (Anonymous, 1962). In either event, this is hardly the logical answer to the problem of how to reach the moon, or Venus. But an obvious conclusion is that an end must come to the upward spiral of human population.

Let us consider for a moment the basis upon which Bonner's estimate of a carrying capacity of 50 billion was made. It assumes that all the reasonably flat, tropical and temperate areas (including deserts, irrigated with reclaimed sea water) are farmed with an intensity characterized by Japan's modern-day agriculture (which approaches very closely the upper limit of crop yield possible with plants now available; Bonner, 1962), and that all people are vegetarians. As Bonner (1961) points out, it would be a world twenty times as crowded as today's, and one could not afford the luxury of pigs, cows, horses, dogs, cats; probably not even strange creatures in zoos. At that stage animal scientists, too, would become an extinct species.

Bonner (1961) also indicates the basis for maintaining 16 billion, and 8 to 10 billion. For 16 billion, the present Japanese level of productivity would have to spread over all the world's presently cultivated area plus an additional 50 percent, and all would have to deny themselves the luxury of animal products. At the lower level of 8 to 10 billion, the Japanese level of efficiency would have to be spread over all of Asia, and an agriculture equivalent in efficiency to that of present-day Western Europe would have to be spread over the rest of the world's agricultural lands, which would have in the meantime been expanded by 50 percent.

Assuming that the population does reach 6.28 billion in 2000 A.D. and that, during the following half-century it reaches only slightly more than double that number, we may contemplate a population of the order of 13 billion in 2050 A.D. This is not very different from Bonner's (1961) estimate of some 15,000 million people in another 100 years. Even though estimates so far ahead are highly speculative, they provide a basis for considering the nature of the problem.

The availability of land for various uses in 1959, and estimated availabilities in 2000 and 2050 A.D. based on the assumptions stated above, regarding population levels, and the pattern of land use remains unchanged, are shown in Figure 6. This chart brings out very sharply the degree to which the world may shrink, in terms of land availability per person. Also, it underlines the question raised earlier: Can the average acre be made to produce twice as much by the turn of this century, and perhaps five times as much by 2050 A.D., as it did in the late 1950's?